AN ESSAY ON

THE

Physiology of Impregnation.

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The subject of reproduction is one that has been fruitful in theories and hypotheses: the ultimate nature of the process however, still involved in obscurity, must remain among the mysterious, and the investigating mind, having so far failed, to penetrate the darkness in which it is shrouded, can do little else than speculate. Yet it is a subject full of interest, and one that merits more than a passing consideration, indeed, as Meigs beautifully expresses it; "it demands the most careful study of all persons desirous to become acquainted with those miraculous powers and actions of the living body that result in perfecting a human being, the crowning work of the Deity in creation, who thus ordains man to come forth from the darkness of nonentity, to shine upon the stage of the world,

and there to act his part in Life's great dra=
ma."

It was the doctrine of Hippocrates, whose sys=
tem was adopted by the greatest number of the an=
cient philosophers, that the female furnished a
seminal fluid similar to the spermatic fluid
of the male; and that the union of these two
fluids, or seeds, in coition was the origin of the
foetus. The same fallacious opinion obtains among
many persons at this day.

Many other theories, some plausable, even ingeni=
ous, some erroneus and absurd, have been promul=
gated by various physiologists since the time
of Hippocrates, but none of them having cleared
the mystery of the generative process, they were
successively abandoned to give place to others.

It remained, however, for modern science
to shed the first light upon this important and
interesting subject. The labors of De Graaf, who
first accurately described the vesicles existing

in the ovary, which bear his name; and, still later, the researches of Charles Ernest Baer, to whom belongs the honor of having first discovered and demonstrated that there exists within the Graafian vesicle an ovum, succeeded in establishing beyond a doubt, the analogy between vivíparous and oviparous animals, and also in confirming the correctness of the theory of Harvey, "Omne vivum ex ovo."

The ovary of the female was thus found to contain the germ cell or the egg; these eggs had previously escaped detection on account of their extreme minuteness, measuring only, according to Bischoff, from the $\frac{1}{240}$ to the $\frac{1}{120}$ of an inch in diameter. Notwithstanding their extremely small size, each ovum presents all the characteristics of the larger gallinaceous egg. The cavity of the Graafian vesicle, or ovisac, is filled with an albuminous fluid, in which floats the ovum. The external in-

vestment of the ovum is the vitelline mem=
brane — thin and transparent; within it is
the yelk or vitellus, a granular fluid, sim=
ilar in all respects to the yolk of an egg; in
the substance of the yolk is imbedded the
"germinal vesicle", and on the periphery of
the germinal vesicle may be seen the "ger=
minal spot".

Such is a brief description of the human o=
vum, and we see that the parts of which
it is composed, are essentially similar to
those constituting the eggs of oviparous an=
imals.

It now remains to say something concerning
the fluid furnished by the male, and with
which the ovule is impregnated. This fluid
of the male is known as the spermatic fluid,
and consists essentially of the semen se=
creted by the testicles. It is a whitish, viscid,
albuminous fluid, and, when examined under

the microscope is found to consist - 1st. of an innumerable quantity of minute, and peculiar bodies, named Spermatozoa or Spermatozoids. These spermatozoa are met with in the spermatic fluid of all animals capable of fecundating, and consist of a somewhat flattened triangular-shaped enlargement, termed the "head"; this head constitutes about one-tenth of the entire length of the spermatozoon. The remaining portion, called the "tail," is long, slender, and tapering, and towards the extremity becomes so fine that it cannot be traced. They are from the $\frac{1}{500}$ to the $\frac{1}{600}$ of an inch in length, and move about in the spermatic fluid at the rate of about an inch in thirteen minutes.

It also contains little granular bodies, sometimes very few in number, at other times more numerous, but always less so than the animalcules.

At the time of leaving the testicle, the sperm consists almost entirely of the spermatozoa, crowded together in a whitish, semi-fluid mass, but as it passes onward to the point of evacuation it receives successively the secretions from the epididymis, vas deferens, the prostate and Cowper's glands, and the mucus from the urethra.

It would seem from several considerations, that of all its ingredients, the spermatozoa constitute the essential part of the seminal fluid, and that the different secretions of which it is composed, serve only for its dilution, thus rendering it a more favorable medium for their diffusion.

The spermatozoa do not appear in the human species before puberty; mules, and other hybrids, are incapable of procreation, and it is found, that, although they have semen, it is destitute of these animalculae. The experiments of Spallanzani

upon the semen of frogs proved, that if the spermatozoa be separated from the sperm, the filtered liquid is destitute of any fecundating properties; while the spermatozoa thus separated, if mixed with a sufficient quantity of fluid of the requisite density for dilution, may be successfully used for impregnation. If the testicles be removed, although the rest of the organs remain perfect, the procreative power is lost, while the removal or imperfection of the other generative organs does not necessarily prevent impregnation.

Embryologists appear universally to concur in the opinion, that absolute contact of the spermatozoa of the male with the ovum of the female is indispensable to fecundation, and many circumstances prove that among the lower orders of animals such is actually the case. Take for example, the fish; the female distended with eggs deposits them in some place favorable to the

development of the young, and there leaves them to be fecundated by the Sperm which the male discharges over them. Among frogs the male firmly fastens himself on the back of the female, and continues there during the whole period of the expulsion of the ovum, impregnating the ova as they pass from the female beneath him.

Thus in the lower tribes of animals, it will be seen that the fertilization of the ova is accomplished without any sexual congress; the spermatic fluid of the male coming into direct contact with the ova previously deposited by the female. We must by analogy conclude that mammalia, where impregnation and development take place in the body of the female, are subject to the same law.

But where does this contact - this union of the male and female germs occur? Is it in the uterus, is it in the oviduct, or is it in the ovary?.

Says Cazeaux, after having described the experiments of Bischoff. "Such results evidently prove

that fecundation sometimes takes place in the ovary; but are we thence to conclude that it is possible in that organ alone? If spontaneous ovulation be an incontestable fact, may it not be supposed that the ovule after having left the ovary, can encounter the spermatic fluid and become fecundated, whether it be in the Fallopian tubes or even in the uterine cavity." (Vid. page 35.)

Sally Dalton. (vid. p. 562.) "The contact of the sperm with the egg, and the fecundation of the latter, take place in the generative passages of the female; either in the uterus, the Fallopian tubes, or even upon the surface of the ovary."

Carpenter also remarks that fecundation may occur before the ovule has finally escaped from the ovarium, or shortly after it has quitted it. All these authorities agree that the course of the spermatic fluid is upwards through the cavity of the uterus, and into the Fallopian tubes. The manner in which this passage is accomplished is thus explained by

Cazeaux.- "We answer that, in the great majority of cases, it is evident that the sperm, having first reached the uterus, upon the neck of which it was thrown by the membranum virile, travels through the tube until it arrives there (i.e. at the ovary). This course is certainly due, 1st. to the movements proper to the womb and tubes; for in the latter a rapid contraction is observed following the direction from the vagina towards the ovary, which of course, is calculated to assist the progression of the sperm, and 2nd. to the movements proper of the spermatozoa which of themselves facilitate their own advancement."

That fecundation does take place in the ovarium is an incontrovertable fact and an almost universally acknowledged one: an abundance of the most conclusive evidence may be had in support of this opinion. Is it ever accomplished in the uterus or Fallopian tubes as Cazeaux declares it may be? There is certainly no positive proof that it is. And there are several phenomena which such a

theory fails to account for.

Among the several considerations as reasons for adopting the theory that impregnation is limited to the ovarium alone as its seat, we would mention the following.

1. The possibility of conception without regard to the period at which copulation occurs. Instances are certainly not unfrequent when conception has taken place five or six days, or even longer after the conclusion of the menstrual period. Take a well known case for example, that of the Jewish females, who religiously abstain from sexual intercourse for eight or even thirteen days after the cessation of the catamenia, and yet their fertility is remarkable. Now is it reasonable to suppose that the ovule has been stored up during the whole of this period in some recess of the female generative apparatus, there to await the pleasure of the fecundating influence of the seminal fluid, preserving its aptitude for procreation

all the while? It is affirmed by Bischoff that by the time the ovule has reached the lower end of the Fallopian tube, all its capacity for impregnation is lost; it is also the opinion of M. Coste one of the most eminent of the French embryologists that this capacity is lost within a few days after it is set free. Says Dalton "if coitus does not take place after the discharge of the egg from the ovary, it passes downward into the uterus, looses its vitality after a short time, and is carried away with the uterine secretions."

From these statements the following deduction must be conceded, namely that in the case mentioned the vitality of the ovule would be gone before copulation took place, and would therefore be opposed to the idea that impregnation may be effected in the tubes or uterus.

2. The development of a foetus in the substance of the ovarium, or what is known as ovarian pregnancy, unequivocally proves that fecun-

dation occurs in the ovary and not in the uterus.

3. Take another illustration to strengthen this point. It is a well known fact that a Turkey cock may mate with the hen but once in the year, and yet all the eggs which she lays during the season are fertilized. In this case there is not only one egg to fecundate, but several; the development and maturation of these eggs are gradual, and their expulsion occurs singly. It is therefore obvious that they were either all impregnated at once and consequently before they had quitted the ovisac, or else we must adopt a notion which would seem not only improbable, but impossible, namely, that the spermatic fluid remains stored up in some nook of the cloaca to be used as occasion required in impregnating the eggs one by one as they escaped from the ovisac.

With these remarks we proceed to another.

portion of our subject. According to the authority quoted above, the Spermatic fluid would reach the ovary by passing through the uterus and Fallopian tubes. and it is on this point that we observe a mass of absurdity and contradiction. Cazeaux says, page 35 in describing how the spermatazoa reach the ovary; "This course is certainly due, 1st. to the movements proper of the womb and tubes: for in the latter, a rapid contraction is observed following the direction from the vagina towards the ovary, which of course, is calculated to assist the progression of the Sperm." Now it would appear that he had forgotten as he wrote, as on the next page he gives the tubes a motion diametrically opposite, or at least the result of that motion the opposite, for he there says: "the ovule, having escaped from the vesicle, immediately engages in their canal; and being pressed onward by the peristaltic action of the tubes, advances

step by step through this duct, and finally arrives in the uterine cavity. But Carpenter denies the possibility of the spermatozoa reaching the ovary by any such means; he affirms, "a peristaltic action of the Fallopian tubes themselves may be generally noticed in animals killed soon after sexual intercourse; but this peristaltic action is from instead of towards the ovaries. It has been supposed that the action of the cilia which line the Fallopian tubes might account for their transit; but the direction of this is from the ovary towards the uterus and would therefore be opposed to it.

Even admitting the possibility of the spermatozoa being able to pass up into the uterus and through the tubes in the face of all the objections, would this explain how they reach the ovary? We know, that just before the menses appear, the whole generative apparatus of the female becomes congested; the tube then made

erectile by being filled with blood, are applied to the surface of the ovary to receive the ovule about to be discharged. But this phenomenon does not occur except at these periods, therefore the sperm, having advanced as far as the fimbriated extremity of the tube, would still be unable to reach the ovary, and consequently would either perish there or drop into the cavity of the abdomen.

We might therefore from these facts reasonably infer that such a cause for the spermatic fluid was not possible, and the evidence which could be obtained from the occurrence of tubal or interstitial pregnancies would seem to strengthen this conclusion, but these are liable to objection on the ground of uncertainty as how long the effacement had existed - whether before or after the conception. Fortunately we are able to obtain cases that are not involved in this uncertainty, and which consequently

place the matter beyond the shadow of a doubt.

In support of this statement I would adduce the following case in point.

The history of the case is as follows: A woman 45 years of age was admitted into St. Mary's Hospital, laboring under a vesico-uterine fistula. The operation performed to remedy this evil was to completely close up the os-uteri, so as prevent the urine from escaping, but to leave the fistulous opening uninterfered with. This was done by denuding the edges of the os and bringing them together by means of silver sutures. The wound healed soundly, the incontinence of urine was arrested, and the woman menstruated through the bladder, and continued to do so for three months, when the operator lost sight of her for a time. The operation was performed on the 14th. of May 1862.

"Towards the end of the year, however, she again

applied to me, telling me that since August or September she had ceased to menstruate and that she had experienced various uncomfortable sensations in the uterine region, and had been increasing in size. On investigation, I found that there was certainly a tumor in the hypogastric region, which appeared to be an enlarged uterus; but on examination per vaginam the os-uteri appeared to be as firmly closed as when she left the hospital in June."

The operator naturally concluded, that the fistulous opening had closed, and that the accumulated menstrual fluid was the cause of the enlargement, for he says: "Pregnancy with the os-uteri firmly closed, was a contingency which never presented itself to my imagination." The appropriate treatment, therefore appeared to be to re-open the os-uteri and allow the accumulated matter to escape. This he attempted to do with a knife and failed owing to the firmness of the uniting medium.

"I therefore resorted to a trocar and cannula, but before the trocar could penetrate, I found it necessary to use an unexpected degree of force. The next day I was informed that a considerable quantity of watery fluid had escaped during the afternoon the puncture had been made. On the following day I learned, to my extreme surprise, that she had been taken ill through the night and that a foetus of about four months had made its appearance"
(Vid. Braithwaite's Retrospect. July 1864. Art. 97.)

But how, then, can conception be explained? In investigating the development of the organs in the embryo we find that what in the foetus constitute the Wolffian bodies, toward the end of foetal life gradually retrograde in development; so that at that period the only vestige of them is to be found as a shrunk rudiment situated (in the male) near the testes to which their excretory ducts serve as outlets, becoming the 'vasa deferentia'. Now in the function of reproduction the male is the "giving or impregnating

agent while the female is the "receiving". The testicles in man, having their homologues in the ovaries of the female, have efferent ducts, the "vasa deferentia", which must also have their homologous ducts existing in the female. – the question then arises what constitutes them – The Fallopian tubes? They have usually been considered so; yet this does not seem to be really the case; for the former are derived from the excretory ducts of the Wolffian bodies, whilst the latter are independant formations. These corresponding and "efferent" ducts must exist in the female organs and will constitute the route by which the sperm reaches the ovary. In the female ruminants and in the pig the ducts of the Wolffian bodies remain open and constitute "Gaertner's Canals" The most likely situation of this duct in the human female must be analagous to these Canals of Gaertner, and would therefore lead from the vagina into the ovary itself. Such a canal has been actually observed by several French physiologists. That it must exist there is scarcely ~~this is scarcely~~ room for doubt and Time, the great discoverer of Truth, will perhaps determine this important question.